# Study Skills for Chemistry

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Your success in this course will depend on your ability to apply some basic study skills to learning the material. Studying chemistry can be difficult, but you can make it easier using simple strategies for dealing with the concepts and problems. Becoming skilled in using these strategies will be your keys to success in this and many other courses.

**Reading the Text**

- **Read the assigned material before class** so that the class lecture makes sense. Use a dictionary to help you interpret vocabulary. Remember while reading to figure out what information is important.
  
  Working together with others using Paired Reading and Discussion strategies can help you decide what is important and clarify the material. (For more discussion, see Other Reading Strategies on page 853.)

- **Select a quiet setting** away from distractions so that you can concentrate on what you are reading.

- **Have a pencil and paper nearby to jot down notes and questions** you may have. Be sure to get these questions answered in class. Power Notes (see page 849) can help you organize the notes you take and prepare you for class.

- **Use the Objectives in the beginning of each section as a list of what you need to know** from the section. Teachers generally make their tests based on the text objectives or their own objectives. Using the objectives to focus your reading can make your learning more efficient. Using the K/W/L strategy (see page 851) can help you relate new material to what you already know and what you need to learn.

**Taking Notes in Class**

- **Be prepared to take notes during class.** Have your materials organized in a notebook. Separate sheets of paper can be easily lost.

- **Don’t write down everything your teacher says.** Try to tell which parts of the lecture are important and which are not. Reading the text before class will help in this. You will not be able to write down everything, so you must try to write down only the important things.

- **Recopying notes later is a waste of time** and does not help you learn material for a test. Do it right the first time. Organize your notes as you are writing them down so that you can make sense of your notes when you review them without needing to recopy them.

**Reviewing Class Notes**

- **Review your notes as soon as possible after class.** Write down any questions you may have about the material covered that day. Be sure to get these questions answered during the next class. You can work with friends to use strategies such as Paired Summarizing and L.I.N.K. (See page 853.)

- **Do not wait until the test to review.** By then you will have forgotten a good portion of the material.

- **Be selective about what you memorize.** You cannot memorize everything in a chapter. First of all, it is too time consuming. Second, memorizing and understanding are not the same thing. Memorizing topics as they appear in your notes or text does not guarantee that you will be able to correctly answer questions that require understanding of those topics. You should only memorize material that you understand. Concept Maps and other Reading Organizers, Sequencing/Pattern Puzzles, and Prediction Guides can help you understand key ideas and major concepts. (See pages 846, 852, and 854.)
**Working Problems**

In addition to understanding the concepts, the ability to solve problems will be a key to your success in chemistry. You will probably spend a lot of time working problems in class and at home. The ability to solve chemistry problems is a skill, and like any skill, it requires practice.

- **Always review the Sample Problems in the chapter.** The Sample Problems in the text provide road maps for solving certain types of problems. Cover the solution while trying to work the problem yourself.

- **The problems in the Chapter Review are similar to the Sample Problems.** If you can relate an assigned problem to one of the Sample Problems in the chapter, it shows that you understand the material.

- **The four steps: Gather information, Plan your work, Calculate, and Verify should be the steps you go through when working assigned problems.** These steps will allow you to organize your thoughts and help you develop your problem-solving skills.

- **Never spend more than 15 minutes trying to solve a problem.** If you have not been able to come up with a plan for the solution after 15 minutes, additional time spent will only cause you to become frustrated. What do you do? Get help! See your teacher or a classmate. Find out what it is that you do not understand.

- **Do not try to memorize the Sample Problems; spend your time trying to understand how the solution develops.** Memorizing a particular sample problem will not ensure that you understand it well enough to solve a similar problem.

- **Always look at your answer and ask yourself if it is reasonable and makes sense.** Check to be sure you have the correct units and numbers of significant figures.

**Completing Homework**

Your teacher will probably assign questions and problems from the Section Reviews and Chapter Reviews or assign Concept Review worksheets. The purpose of these assignments is to review what you have covered in class and to see if you can use the information to answer questions or solve problems. As in reviewing class notes, do your homework as soon after class as possible while the topics are still fresh in your mind. Do not wait until late at night, when you are more likely to be tired and to become frustrated.

**Reviewing for an exam**

- **Don’t panic and don’t cram!** It takes longer to learn if you are under pressure. If you have followed the strategies listed here and reviewed along the way, studying for the exam should be less stressful.

- **When looking over your notes and concept maps, recite ideas out loud.** There are two reasons for reciting:
  1. You are hearing the information, which is effective in helping you learn.
  2. If you cannot recite the ideas, it should be a clue that you do not understand the material, and you should begin rereading or reviewing the material again.

- **Studying with a friend provides a good opportunity for recitation.** If you can explain ideas to your study partner, you know the material.

**Taking an exam**

- **Get plenty of rest before the exam** so that you can think clearly. If you have been awake all night studying, you are less likely to succeed than if you had gotten a full night of rest.

- **Start with the questions you know.** If you get stuck on a question, save it for later. As time passes and you work through the exam, you may recall the information you need to answer a difficult question or solve a difficult problem.

Good luck!
Making concept maps can help you decide what material in a chapter is important and how to efficiently learn that material. A concept map presents key ideas, meanings, and relationships for the concepts being studied. It can be thought of as a visual road map of the chapter. Learning happens efficiently when you use concept maps because you work with only the key ideas and how they fit together.

The concept map shown as Map A was made from vocabulary terms from the first few chapters of the book. Vocabulary terms are generally labels for concepts, and concepts are generally nouns. In a concept map, linking words are used to form propositions that connect concepts and give them meaning in context. For example, on the map above, “matter is described by physical properties” is a proposition.

Studies show that people are better able to remember materials presented visually. A concept map is better than an outline because you can see the relationships among many ideas. Because outlines are linear, there is no way of linking the ideas from various sections of the outline. Read through the map to become familiar with the information presented. Then look at the map in relation to all of the text pages in the first few chapters; which gives a better picture of the important concepts—the map or the full chapters?
To Make a Concept Map

1. List all the important concepts.
   We’ll use some of the boldfaced and italicized terms from the chapter “Matter and Energy.”
   
   | matter  | mixture  |
   | compound | pure substance |
   | element   | heterogeneous mixture |
   | homogeneous mixture |

   • From this list, group similar concepts together. For example, one way to group these concepts would be into two groups—one that is related to mixtures and one that is related to pure substances.

   mixture  
   pure substance  
   heterogeneous mixture  
   compound  
   homogeneous mixture  
   element

2. Select a main concept for the map.
   We will use matter as the main concept for this map.

3. Build the map by placing the concepts according to their importance under the main concept. For this map the main concept is matter.
   One way of arranging the concepts is shown in Map B.

MAP B

```
    matter
     /    
  pure substances  mixtures
   /    
  elements  compounds
            /  
          homogeneous mixtures  heterogeneous mixtures
```
4. Add linking words to give meaning to the arrangement of concepts.

When adding the links, be sure that each proposition makes sense. To distinguish concepts from links, place your concepts in circles, ovals, or rectangles, as shown in the maps. Then make cross-links. Cross-links are made of propositions and lines connecting concepts across the map. Links that apply in only one direction are indicated with an arrowhead. Map C is a finished map covering the main ideas listed in Step 1.

Making maps might seem difficult at first, but the process forces you to think about the meanings and relationships among the concepts. If you do not understand those relationships, you can get help early on.

Practice mapping by making concept maps about topics you know. For example, if you know a lot about a particular sport, such as basketball, or if you have a particular hobby, such as playing a musical instrument, you can use that topic to make a practice map. By perfecting your skills with information that you know very well, you will begin to feel more confident about making maps from the information in a chapter.

Remember, the time you devote to mapping will pay off when it is time to review for an exam.

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**PRACTICE**

1. Classify each of the following as either a concept or linking word(s).

   a. classification __________________________

   b. is classified as __________________________

   c. forms __________________________

   d. is described by __________________________

   e. reaction __________________________

   f. reacts with __________________________

   g. metal __________________________

   h. defines __________________________

2. Write three propositions from the information in Map A.

   _______________________________________

   _______________________________________

   _______________________________________

3. List two cross-links shown on Map C.

   _______________________________________

   _______________________________________
Making Power Notes

Power notes help you organize the chemical concepts you are studying by distinguishing main ideas from details. Similar to outlines, power notes are linear in form and provide you with a framework of important concepts. Power notes are easier to use than outlines because their structure is simpler. Using the power notes numbering system you assign a 1 to each main idea and a 2, 3, or 4 to each detail.

Power notes are an invaluable asset to the learning process, and they can be used frequently throughout your chemistry course. You can use power notes to organize ideas while reading your text or to restructure your class notes for studying purposes.

To learn to make power notes, practice first by using single-word concepts and a subject you are especially interested in, such as animals, sports, or movies. As you become comfortable with structuring power notes, integrate their use into your study of chemistry. For an easier transition, start with a few boldfaced or italicized terms. Later you can strengthen your notes by expanding these single-word concepts into more-detailed phrases and sentences. Use the following general format to help you structure your power notes.

**Power 1:** Main idea
- **Power 2:** Detail or support for power 1
- **Power 3:** Detail or support for power 2
- **Power 4:** Detail or support for power 3

1. **Pick a Power 1 word from the text.**

   The text you choose does not have to come straight from your chemistry textbook. You may be making power notes from your lecture notes or from an outside source. We’ll use the term atom found in the chapter entitled “Atoms and Moles” in your textbook.

   **Power 1:** Atom

2. **Using the text, select some Power 2 words to support your Power 1 word.**

   We’ll use the terms nucleus and electrons, which are two parts of an atom.

   **Power 1:** Atom
   - **Power 2:** Nucleus
   - **Power 2:** Electrons

3. **Select some Power 3 words to support your Power 2 words.** We’ll use the terms positively charged and negatively charged, two terms that describe the Power 2 words.

   **Power 2:** Nucleus
   - **Power 3:** Positively charged
   - **Power 3:** Protons
   - **Power 4:** Positively charged
   - **Power 3:** Neutrons
   - **Power 4:** No charge
   - **Power 2:** Electrons
   - **Power 3:** Negatively charged

4. **Continue to add powers to support and detail the main idea as necessary.**

   There are no restrictions on how many power numbers you can use in your notes. If you have a main idea that requires a lot of support, add more powers to help you extend and organize your ideas. Be sure that words having the same power number have a similar relationship to the power above. Power 1 terms do not have to be related to each other. You can use power notes to organize the material in an entire section or chapter of your text. Doing so will provide you with an invaluable study guide for your classroom quizzes and tests.

   **Power 1:** Atom
   - **Power 2:** Nucleus
   - **Power 3:** Positively charged
   - **Power 3:** Protons
   - **Power 4:** Positively charged
   - **Power 3:** Neutrons
   - **Power 4:** No charge
   - **Power 2:** Electrons
   - **Power 3:** Negatively charged

**Practice**

1. Use a periodic table and the power notes structure below to organize the following terms: alkaline-earth metals, nonmetals, calcium, sodium, halogens, metals, alkali metals, chlorine, barium, and iodine.

   1 _______________________________
   2 _______________________________
   3 _______________________________
   4 _______________________________
   1 _______________________________
   2 _______________________________
   3 _______________________________
   4 _______________________________

   **Power 1:** Atom
   - **Power 2:** Nucleus
   - **Power 3:** Positively charged
   - **Power 3:** Protons
   - **Power 4:** Positively charged
   - **Power 3:** Neutrons
   - **Power 4:** No charge
   - **Power 2:** Electrons
   - **Power 3:** Negatively charged

   2 _______________________________
   3 _______________________________
   4 _______________________________
Making Two-Column Notes

Two-column notes can be used to learn and review definitions of vocabulary terms, examples of multiple-step processes, or details of specific concepts. The two-column-note strategy is simple: write the term, main idea, step-by-step process, or concept in the left-hand column, and the definition, example, or detail on the right.

One strategy for using two-column notes is to organize main ideas and their details. The main ideas from your reading are written in the left-hand column of your paper and can be written as questions, key words, or a combination of both. Details describing these main ideas are then written in the right-hand column of your paper.

1. Identify the main ideas. The main ideas for a chapter are listed in the section objectives. However, you decide which ideas to include in your notes. For example, here are some main ideas from the objectives in Section 4-2.

- Describe the locations in the periodic table and the general properties of the alkali metals, alkaline-earth metals, the halogens, and the noble gases.

2. Divide a blank sheet of paper into two columns and write the main ideas in the left-hand column. Summarize your ideas using quick phrases that are easy for you to understand and remember. Decide how many details you need for each main idea, and write that number in parentheses under the main idea.

3. Write the detail notes in the right-hand column. Be sure you list as many details as you designated in the main-idea column. Here are some main ideas and details about some of the groups in the Periodic Table.

The two-column method of review is perfect whether you use it to study for a short quiz or for a test on the material in an entire chapter. Just cover the information in the right-hand column with a sheet of paper, and after reciting what you know, uncover the notes to check your answers. Then ask yourself what else you know about that topic. Linking ideas in this way will help you to gain a more complete picture of chemistry.
Using the K/W/L Strategy

The K/W/L strategy stands for “what I Know—what I Want to know—what I Learned.” You start by brainstorming about the subject matter before reading the assigned material. Relating new ideas and concepts to those you have learned previously will help you better understand and apply the new knowledge you obtain. The section objectives throughout your textbook are ideal for using the K/W/L strategy.

1. Read the section objectives. You may also want to scan headings, boldfaced terms, and illustrations before reading. Here are two of the objectives from Section 1-2 to use as an example.

   - Explain the gas, liquid, and solid states in terms of particles.
   - Distinguish between a mixture and a pure substance.

2. Divide a sheet of paper into three columns, and label the columns “What I Know,” “What I Want to Know,” and “What I Learned.”

3. Brainstorm about what you know about the information in the objectives, and write these ideas in the first column. Because this chart is designed primarily to help you integrate your own knowledge with new information, it is not necessary to write complete sentences.

4. Think about what you want to know about the information in the objectives, and write these ideas in the second column. Include information from both the section objectives and any other objectives your teacher has given you.

5. While reading the section or afterwards, use the third column to write down the information you learned. While reading, pay close attention to any information about the topics you wrote in the “What I Want to Know” column. If you do not find all of the answers you are looking for, you may need to reread the section or reference a second source. Be sure to ask your teacher if you still cannot find the information after reading the section a second time.

It is also important to review your brainstormed ideas when you have completed reading the section. Compare your ideas in the first column with the information you wrote down in the third column. If you find that some of your brainstormed ideas are incorrect, cross them out. It is extremely important to identify and correct any misconceptions you had prior to reading before you begin studying for your test.

<table>
<thead>
<tr>
<th>What I Know</th>
<th>What I want to Know</th>
<th>What I Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>* gas has no definite shape or volume</td>
<td>* how gas, liquid, and solid states are related to particles</td>
<td>* molecules in solid and liquid states are close together, but are far apart in gas state</td>
</tr>
<tr>
<td>* liquid has no definite shape, but has definite volume</td>
<td>* how mixtures and pure substances are different</td>
<td>* molecules in solid state have fixed positions, but molecules in liquid and gas states can flow</td>
</tr>
<tr>
<td>* solid has definite shape and volume</td>
<td></td>
<td>* mixtures are combinations of pure substances</td>
</tr>
<tr>
<td>* mixture is a combination of substances</td>
<td></td>
<td>* pure substances have fixed compositions and definite properties</td>
</tr>
<tr>
<td>* pure substance has only one component</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
You can use pattern puzzles to help you remember sequential information. Pattern puzzles are not just a tool for memorization. They also promote a greater understanding of a variety of chemical processes, from the steps in solving a mass-mass stoichiometry problem to the procedure for making a solution of specified molarity.

Here’s a step-by-step example showing how to make a pattern puzzle, and how to use it to help you study. For other topics that require remembering information in a particular order, just follow the same steps.

1. **Write down the steps of a process in your own words.**

   For an example, we will use the process for converting the amount of a substance in moles to mass in grams. (See Sample Problem D in the chapter on “Atoms and Moles.”)

   On a sheet of notebook paper, write down one step per line, and do not number the steps.

   Do not copy the process straight from your textbook. Writing the steps in your own words promotes a more thorough understanding of the process.

   You may want to divide longer steps into two or three shorter steps.

2. **Cut the sheet of paper into strips with only one step per strip of paper.** Shuffle the strips of paper so that they are out of sequence.

3. **Place the strips in their proper sequence.** Confirm the order of the process by checking your text or your class notes.

Pattern puzzles are especially helpful when you are studying for your chemistry tests. Before tests, use your puzzles to practice sequencing and to review the steps of chemistry processes. You and a classmate can also take turns creating your own pattern puzzles of different chemical processes and putting each other’s puzzles in the correct sequence. Studying with a classmate in this manner will help make studying fun and will enable you to help each other.
Other Reading Strategies

Brainstorming

Brainstorming is a strategy that helps you recognize and evaluate the knowledge you already have before you start reading. It works well individually or in groups. When you brainstorm, you start with a central term or idea, then quickly list all the words, phrases, and other ideas that you think are related to it.

Because there are no “right” or “wrong” answers, you can use the list as a basis for classifying terms, developing a general explanation, or speculating about new relationships. For example, you might brainstorm a list of terms related to the word element before you read about elements early in the textbook. The list might include gold, metals, chemicals, silver, carbon, oxygen, and water. As you read the textbook, you might decide that some of the terms you listed are not elements. Later, you might use that information to help you distinguish between elements and compounds.

Building/Interpreting Vocabulary

Using a dictionary to look up the meanings of prefixes and suffixes as well as word origins and meanings helps you build your vocabulary and interpret what you read. If you know the meaning of prefixes like kilo- (one thousand) and milli- (one thousandth), you have a good idea what kilograms, kilometers, milligrams, and millimeters are and how they are different. (See Appendix A for a list of SI Prefixes.)

Knowledge of prefixes, suffixes, and word origins can help you understand the meaning of new words. For example, if you know the prefix –poly comes from the word meaning many, it will help you understand what polysaccharides and polymers are.

Reading Hints

Reading hints help you identify and bookmark important charts, tables, and illustrations for easy reference. For example, you may want to use a self-adhesive note to bookmark the periodic table in the chapter describing it or on the inside back cover of your book so you can easily locate it and use it for reference as you study different aspects of chemistry and solve problems involving elements and compounds.

Interpreting Graphic Sources of Information

Charts, tables, photographs, diagrams, and other illustrations are graphic, or visual, sources of information. The labels and captions, together with the illustrations help you make connections between the words and the ideas presented in the text.

Reading Response Logs

Keeping a reading response log helps you interpret what you read and gives you a chance to express your reactions and opinions about what you have read. Draw a vertical line down the center of a piece of paper. In the left-hand column, write down or make notes about passages you read to which you have reactions, thoughts, feelings, questions, or associations. In the right-hand column, write what those reactions, thoughts, feelings, questions, or associations are. For example, you might keep a reading response log when studying about Nuclear Energy.
Comparing and Contrasting

Comparing and contrasting is a strategy that helps you note similarities and differences between two or more objects or events. When you determine similarities, you are comparing. When you determine differences, you are contrasting.

You can use comparing and contrasting to help you classify objects or properties, differentiate between similar concepts, and speculate about new relationships. For example, as you read Chapters 1 and 2 you might begin to make a table in which you compare and contrast metals, nonmetals, and metalloids. As you continue to learn about these substances in the chapter on the Periodic Table, you can add to your table, giving you a better understanding of the similarities and differences among elements.

Identifying Cause and Effect

Identifying causes and effects as you read helps you understand the material and builds logical reasoning skills. An effect is an event or the result of some action. A cause is the reason the event or action occurred. Signal words, such as because, so, since, therefore, as a result, and depends on, indicate a cause-and-effect relationship.

You can use arrows to show cause and effect. For example, you might write this cause-and-effect relationship as you read about gases: At constant pressure, increase in temperature (cause) \( \rightarrow \) increase in gas volume (effect).

Making a Prediction Guide

A prediction guide is a list of statements about which you express and try to justify your opinions based on your current knowledge. After reading the material, you re-evaluate your opinion in light of what you learned. Using prediction guides helps you evaluate your knowledge, identify assumptions you may have that could lead to mistaken conclusions, and form an idea of expected results.

1. Read the statements your teacher writes on the board. For example, look at the five statements from Dalton’s theory listed in the chapter “Atoms and Moles.”

2. Decide whether you think each statement is true or false and discuss reasons why you think so.

3. After reading the section, re-evaluate your opinion of each statement. Discuss why your opinion changed or remained the same. Find passages in the text that account for the change of reinforcement of your opinions. For example, you might have agreed with all five statements from Dalton’s theory before reading the text. Then, after reading about atoms and subatomic particles, you might have changed your opinion about the first statement.

Reading Organizers

Arranging information in tables or two-column notes makes it easier for you to understand. A table consists of rows and columns. The column headings and row headings list the items and the characteristics to be organized in the table. Here is a table for organizing information about the particles that make up an atom.

<table>
<thead>
<tr>
<th>Particle</th>
<th>Symbol</th>
<th>Charge</th>
<th>Mass No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>electron</td>
<td>( e^- )</td>
<td>(-1)</td>
<td>0</td>
</tr>
<tr>
<td>proton</td>
<td>( p^+ )</td>
<td>(+1)</td>
<td>1</td>
</tr>
<tr>
<td>neutron</td>
<td>( n^0 )</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
Cooperative Learning Techniques

Reading with a Partner

Reading with a partner is a strategy that can help you understand what you read and point out where more explanation is needed.

1. First read the text silently by yourself. Use self-adhesive notes to mark those parts of the text that you do not understand. For example, you might have difficulty with some of the material about quantum numbers, while another student understands quantum numbers but has trouble with electron configurations.

2. Work with a partner to discuss the passages each of you marked. Take turns listening and trying to clarify the difficult passages for each other. Together, study the related tables and illustrations and explain to each other how they relate to the text.

3. For concepts that need further explanation, work together to formulate questions for class discussion or for your teacher to answer.

Using L.I.N.K.

The L.I.N.K. strategy stands for List, Inquire, Notes, Know. It is similar to the K/W/L strategy, but you work as a class or in groups.

1. Brainstorm all the words, phrases, and ideas associated with the term your teacher provides. Volunteers can keep track of contributions on the board or on a separate sheet of paper.

2. Your teacher will direct you in a class or group discussion about the words and ideas listed. Now is the time to inquire, or ask your teacher and other students for clarification of the listed ideas.

3. At the end of the discussion, make notes about everything you can remember. Look over your notes to see if you have left anything out.

4. See what you now know about the given concept based on your own experience and the discussion.

Summarizing/Paired Summarizing

A summary is a brief statement of main ideas or important concepts. Making a summary of what you have read provides you with a way to review what you have learned, see what information needs further clarification, and helps you make connections to previously studied material.

Paired summarizing helps strengthen your ability to read, listen, and understand. It is especially useful when a section of text has several subdivisions, each dealing with different topics.

1. First read the material silently by yourself.

2. Then you and your partner take turns being the “listener” and the “reteller.” The reteller summarizes the material for the listener, who does not interrupt until the reteller has finished. If necessary, the reteller may consult the text, and the listener may ask for clarification. The listener then states any inaccuracies or omissions made by the reteller.

3. Work together to refine the summary. Make sure the summary states the important ideas in a clear and concise manner.

Discussing Ideas

Discussing ideas with a partner or in a group before you read is a strategy that can help you broaden your knowledge base and decide what concepts to focus on as you are reading. Discussing ideas after you have read a section or chapter can help you check your understanding, clarify difficult concepts, and lead you to speculate about new ideas.